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(54) PROCEDE D'INERTISATION POUR LA PREVENTION ET L'EXTINCTION DES INCENDIES DANS DES LOCAUX FERMES

(54) INERTING METHOD FOR PREVENTING AND EXTINGUISHING FIRES IN ENCLOSED SPACES

(57)

The invention relates to an inerting method for reducing the risk of and for extinguishing fires in enclosed spaces, and to a device for carrying out this method. The aim of the invention is ensure that a fire can be extinguished effectively whilst keeping the storage requirements for the inert gas cylinders to a minimum. To this end, the oxygen content of the enclosed space is reduced to a set base inerting level and in the event of a fire, is quickly reduced further to a set complete inerting level. The device for carrying out this method is equipped with an oxygen-measuring device in the space being monitored, with a first system for producing the oxygen-expulsion gas or for extracting the oxygen from the space being monitored, a second system for rapidly feeding an oxygen-expulsion gas into the space being monitored and a fire detection device for detecting a fire characteristic in the air in the enclosed space. A control unit is also provided. This control unit sends a base inerting signal to the first system in accordance with the oxygen content of the air in the enclosed space being monitored and a complete inerting signal to the second system in accordance with a detection signal from the fire detection device.

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(12) (19) (CA) **Demande-Application**

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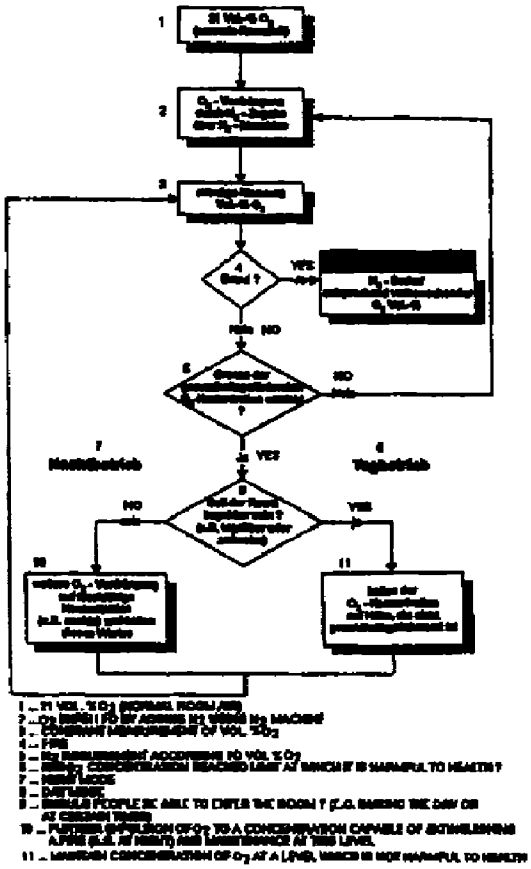
(54) **PROCEDE D'INERTISATION POUR LA PREVENTION ET L'EXTINCTION DES INCENDIES DANS DES LOCAUX FERMES**

(54) **INERTING METHOD FOR PREVENTING AND EXTINGUISHING FIRES IN ENCLOSED SPACES**



(57) L'invention concerne un procédé d'inertisation pour réduire les risques d'incendie et éteindre les incendies dans des locaux fermés, ainsi qu'un dispositif pour mettre en oeuvre ledit procédé. L'invention vise à

(57) The invention relates to an inerting method for reducing the risk of and for extinguishing fires in enclosed spaces, and to a device for carrying out this method. The aim of the invention is ensure that a fire can

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permettre l'extinction efficace d'un incendie, tout en réduisant le plus possible la capacité de stockage nécessaire aux bouteilles de gaz inerte. A cet effet, la teneur en oxygène dans le local fermé est abaissée à un niveau déterminé d'inertisation de base, et, en cas d'incendie, abaissée rapidement davantage à un niveau déterminé d'inertisation totale. Le dispositif pour mettre en oeuvre ledit procédé présente un dispositif de mesure de la teneur en oxygène dans le local à surveiller, un premier système pour produire le gaz refoulant l'oxygène ou pour prélever de l'oxygène dans le local à surveiller, un deuxième système pour introduire brusquement dans le local à surveiller un gaz refoulant l'oxygène, et un dispositif de détection d'incendie pour détecter une caractéristique d'incendie dans l'air du local. Il est également prévu un système de commande qui envoie un signal d'inertisation de base au premier système en fonction de la teneur en oxygène de l'air du local à surveiller, et qui envoie un signal d'inertisation totale au second système en fonction d'un signal de détection provenant du dispositif de détection d'incendie.

be extinguished effectively whilst keeping the storage requirements for the inert gas cylinders to a minimum. To this end, the oxygen content of the enclosed space is reduced to a set base inerting level and in the event of a fire, is quickly reduced further to a set complete inerting level. The device for carrying out this method is equipped with an oxygen-measuring device in the space being monitored, with a first system for producing the oxygen-expulsion gas or for extracting the oxygen from the space being monitored, a second system for rapidly feeding an oxygen-expulsion gas into the space being monitored and a fire detection device for detecting a fire characteristic in the air in the enclosed space. A control unit is also provided. This control unit sends a base inerting signal to the first system in accordance with the oxygen content of the air in the enclosed space being monitored and a complete inerting signal to the second system in accordance with a detection signal from the fire detection device.

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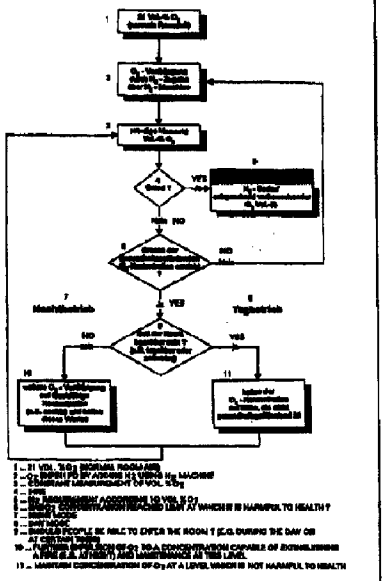
(54) Title: INERTING METHOD FOR PREVENTING AND EXTINGUISHING FIRES IN ENCLOSED SPACES

(54) Bezeichnung: INERTISIERUNGSVERFAHREN ZUR BRANDVERHÜTUNG UND –LÖSCHUNG IN GESCHLOSSENEN RÄUMEN

(57) Abstract

The invention relates to an inerting method for reducing the risk of and for extinguishing fires in enclosed spaces, and to a device for carrying out this method. The aim of the invention is ensure that a fire can be extinguished effectively whilst keeping the storage requirements for the inert gas cylinders to a minimum. To this end, the oxygen content of the enclosed space is reduced to a set base inerting level and in the event of a fire, is quickly reduced further to a set complete inerting level. The device for carrying out this method is equipped with an oxygen–measuring device in the space being monitored, with a first system for producing the oxygen–expulsion gas or for extracting the oxygen from the space being monitored, a second system for rapidly feeding an oxygen–expulsion gas into the space being monitored and a fire detection device for detecting a fire characteristic in the air in the enclosed space. A control unit is also provided. This control unit sends a base inerting signal to the first system in accordance with the oxygen content of the air in the enclosed space being monitored and a complete inerting signal to the second system in accordance with a detection signal from the fire detection device.



(57) Zusammenfassung

Es wird ein Inertisierungsverfahren zur Minderung des Risikos und zum Löschen von Bränden in geschlossenen Räumen sowie eine Vorrichtung zur Durchführung des Verfahrens angegeben. Mit dem Ziel, ein effektives Löschen eines Brandes bei möglichst geringer Lagerkapazität für die Inertgasflaschen zu ermöglichen, sieht das Verfahren vor, daß der Sauerstoffgehalt in dem umschlossenen Raum auf ein bestimmtes Grundinertisierungsniveau abgesenkt und im Falle eines Brandes rasch auf ein bestimmtes Vollinertisierungsniveau weiter abgesenkt wird. Zur Durchführung des Verfahrens ist die Vorrichtung mit einer Sauerstoffmeßvorrichtung in dem zu überwachenden Raum ausgerüstet, mit einer ersten Anlage zur Produktion des sauerstoffverdrängenden Gases oder zur Entnahme von Sauerstoff aus dem zu überwachenden Raum, mit einer zweiten Anlage zum plötzlichen Einleiten eines sauerstoffverdrängenden Gases in den zu überwachenden Raum, und mit einer Branderkennungsvorrichtung zum Detektieren einer Brandkenngröße in der Raumluft. Um die vorstehend geschilderte Zielsetzung zu erreichen, ist eine Steuerung vorgesehen, die in Abhängigkeit des Sauerstoffgehalts der Raumluft des zu überwachenden Raumes ein Grundinertisierungssignal an die erste Anlage abgibt, und die in Abhängigkeit eines Detektionssignals von der Branderkennungsvorrichtung ein Vollinertisierungssignal an die zweite Anlage abgibt.

Inerting method for preventing and extinguishing fires in enclosed spaces

The present invention relates to an inerting method for reducing the risk of and for extinguishing fires in enclosed spaces, and to a device for carrying out this method.

In view of enclosed spaces, into which human beings or animals enter only occasionally, and the installations in which react sensibly to water impacts, it is known to anticipate the risk of fires by reducing the oxygen concentration in the area in question to an average value of about 12 %. Given this oxygen concentration, most combustible materials can no longer burn. The areas concerned are mainly data processing areas, electric switch and distribution rooms, enclosed installations and storing areas containing high-grade economic goods. The extinguishing effect resulting from this method is based on the principle of oxygen expulsion. It is known that the normal ambient air consists of 21 % oxygen, 78 % nitrogen and 1 % of other gases. For extinction the nitrogen concentration in the space concerned is further increased by introducing pure nitrogen so as to reduce the oxygen portion. It is known that an extinguishing effect commences once the oxygen content falls under 15 % by volume. In dependence on the combustible materials in the space concerned it may be required to further reduce the oxygen content to the mentioned 12 % by volume.

With said "inert gas extinguishing technique", as the flooding of a fire hazardous or burning space with oxygen-expulsion gases such as carbon dioxide, nitrogen, rare gases and mixtures thereof is called, the oxygen-expulsion gases are usually stored in a compressed manner in steel cylinders in specific side rooms. In the case of need, the gas is then conducted into the space in question by means of piping

systems and corresponding exit nozzles. Extinction by means of the inert gas technique, however, encounters certain problems and shows clear limits in view of the size of the space. Large spaces having, for instance, a basic area of 20 x 50 m and a 6.5 m height result in a capacity of 6,500 m^3. In accordance with the standards, the steel cylinders used are those having a volumetric capacity of 80 l. Inert gas extinction facilities are filled with a pressure of 200 bar, which is presently the upper standard parameter due to the ultimate loading capacity of the available armatures. With a cylinder pressure of 200 bar, 80 l, for example, hold 18.3 kg nitrogen resulting in 16 m^3 nitrogen in the relaxed state at 1 bar ambient pressure. In order to flood the aforementioned space having a capacity of 6.500 m^3 with inert gas, the contents of about 300 steel cylinders would be required. In a filled state such a cylinder has a weight of about 100 kg, which, given 300 cylinders, would result in a weight of 30 tons. In addition there would be the weight of the pipes and armatures, so that very high demands would have to be made on the load ability of the store rooms. Moreover, a large floor space would be required for such a number of cylinders. Thus, it is evident that the inert gas extinction technique in connection with larger spaces encounters problems in view of the storability and the carrying capacity of the store rooms. To store the cylinders in a cellar is not a satisfying solution either, although the carrying capacity there is not of importance. Long conduits would have to be laid from the cellar to the upper floors involving an additional construction labor, which frequently cannot be coped with later, and moreover prolonging the flow-in time of the inert gas in an inappropriate manner.

It is an object of the present invention to provide an inerting method for reducing the risk of fires and for extinguishing fires in enclosed spaces, allowing an effective

extinction of a fire whilst keeping the storing capacity for the inert gas cylinders at a minimum.

Said object is provided by means of an inerting method of the above-mentioned kind comprising the following process steps: At first, the oxygen content in the enclosed space is reduced to a set base inerting level of, for example, 16 %, and in the event of a fire the oxygen content is further reduced to a set complete inerting level of, for example, 12 % by volume or less. A base inerting level of an oxygen concentration of 16 % by volume does not entail any risk for persons or animals, so that they can still enter the space without any problems. The complete inerting level can either be adjusted at night, when no persons or animals enter the space in question, or directly in response to a detected fire. With an oxygen concentration of 12 % by volume the flammability of most materials has already been sufficiently reduced so that they can no longer start to burn.

The advantages of the inventive method particularly consist in that the number of containers for oxygen-expulsion inert gases required in the event of a fire is clearly reduced. Thus, the total costs for fire prevention and the fire extinction system are considerably reduced. Furthermore, under the constructional aspect, a smaller pressure relief facility is required, as in the event of a fire only a smaller gas volume has to flow in during the short time being available, for which a constructional relief has to be provided.

Moreover, the aforementioned object is provided by means of a device for carrying out said method, comprising the following components: an oxygen measuring device in the space being monitored; a first system for producing the oxygen-expulsion gas or for extracting oxygen from the space being monitored; a second system for rapidly feeding an oxygen-expulsion gas into

the space being monitored; and a fire detection device for detecting a fire characteristic in the air of the enclosed space. For providing a solution to the set object a control unit is provided, which sends a base inerting signal to the first system for producing the oxygen-expulsion gas or for extracting the oxygen in accordance with the oxygen content of the air in the enclosed space being monitored, and which sends a complete inerting signal to the second system in accordance with a detection signal from the fire detection device.

Said inventive device realizes in an ideal manner the connection of the inventive method with a fire detection device. The control unit according to the invention for sending the base inerting signal and the complete inerting signal thereby takes into account the particular conditions of the space being monitored, the base inerting level of which was previously calculated on the basis of size and type of the space.

Advantageous embodiments of the method are disclosed in subclaims 2 to 9, and in view of the device in claims 10 to 13.

The inerting method advantageously comprises the following additional two process steps, which are carried out before the first process step, namely the reduction of the oxygen content to a set base inerting level: In accordance with said embodiment, the oxygen content in the space being monitored is first measured, whereupon the reduction to the base inerting level is carried out in a second process step in response to the measured value of the oxygen. Thus, the inerting method adjusts to certain leakages in the space by means of a classical regulation of the oxygen content in the space being monitored.

A detector for fire characteristics is advantageously integrated into the method, which sends a complete inerting signal in the event of a fire.

Representative air samples are, for instance, constantly extracted from the air in the space being monitored prior to the reduction to a set complete inerting level, which samples are fed to a detector for fire characteristics, which sends a complete inerting signal in the event of a fire. Said embodiment is the process-technical conversion of the connection of a known aspirative fire detection device with the inert gas extinction technique. An aspirative fire detection device hereby refers to a fire detection device actively drawing in a representative portion of the air in the space at a plurality of locations via a piping or channel system and feeding said portion to a measuring chamber comprising a detector for detecting a fire characteristic.

The term "fire characteristic" refers to physical parameters being subject to measurable changes in the environment of an originating fire, for example, the ambient temperature, the solid or liquid or gas contents in the ambient air (formation of smoke in the form of particles or aerosols or vapor) or the ambient radiation.

The method can be carried out in a particularly advantageous manner, if the base inerting level is implemented by means of mechanical production and subsequent introduction of oxygen-expulsion gases, or by means of mechanical oxygen extraction. This is feasible in so far as more time is available for the reduction to the base inerting level, so that a gradual reduction of the oxygen content in the corresponding space by means of a machine is sufficient. In contrast thereto, an introduction of oxygen-expulsion gases into the enclosed space is preferably provided for rapidly obtaining the complete

inerting level, wherein basically all inert gases may be used. Said inert gases may advantageously be provided in gas cylinders, since even with larger spaces the volume to be filled between the base inerting level and the complete inerting level no longer causes problems. Moreover, a mechanical production of oxygen-expulsion gases, for instance by means of a nitrogen machine, is a great advantage, since also gas cylinders being responsible for the complete inerting can thus be refilled upon the use thereof.

It has finally been provided as an advantage that the introduction of the oxygen-expulsion gases is carried out in accordance with the oxygen content measured in the enclosed space, whereby it is achieved that only the amount of gas being required for the complete inerting is fed at all times.

It has already been mentioned that it is one of the advantages of the inventive method that it can be combined with the known fire detection devices. In so-called aspirative fire detection devices it is necessary to constantly control the flow rate of the drawn in representative air portions. According to an embodiment of the inventive device it is provided that the oxygen measuring device for carrying out the method is integrated in the detector housing of the fire detection device, where also the air flow monitoring device is disposed.

The production of the oxygen-expulsion gases for obtaining the base inerting level is advantageously implemented mechanically by means of a nitrogen machine or the like. It had already been mentioned that also the gas cylinders responsible for the complete inerting can thereby be refilled in an advantageous manner, once they have been emptied.

In the following the inventive method is explained in more detail by means of a flow chart.

An enclosed space containing normal air with the common oxygen content of 21 % by volume is to be monitored. In order to reduce the risk of a fire, the oxygen content in the enclosed space is reduced to a set base inerting level by means of introducing nitrogen from a nitrogen machine. The oxygen content in the space being monitored is constantly measured before and simultaneously with the reduction to the base inerting level. The target value was previously calculated on the basis of the properties of the space and the equipment thereof with data processing apparatus and the like. An aspirative fire detection device being provided with a detector for fire characteristics constantly draws in representative portions of the air in the space via a piping or channel system and feeds said portions to the detector for the fire characteristics. If a fire characteristic is detected and, with the usual safety loops, recognized as a fire, the space is rapidly flooded with nitrogen from steel cylinders until a desired oxygen concentration is obtained. Said concentration was previously determined on the basis of the combustible materials in the space.

As long as there is no fire, it is constantly checked by means of the oxygen measuring device, whether a lower threshold value of a noxious oxygen concentration is reached. If this is still not the case, the nitrogen machine still receives the base inerting signal and continues to flood the space with nitrogen. If the noxious threshold value is reached, the target value is inquired as to whether the conditions for a night operation or the conditions for a day operation are to be established. If the space is no longer to be entered by persons or animals, the complete inerting signal is send to the nitrogen machine, whereupon another oxygen expulsion takes place in accordance with the measured oxygen content, until the extinguishing concentration predetermined for the space and the materials contained therein is reached. If the space,

however, is still to be entered, the oxygen concentration is maintained at a non-noxious value of about 16 % by means of the oxygen measuring device.

Patent Claims

1. Inerting method for reducing the risk of and for extinguishing fires in enclosed spaces, comprising the following process steps:
   a) the oxygen content in the enclosed space is reduced to a set base inerting level; and
   b) in the event of a fire, the oxygen content is rapidly further reduced to a set complete inerting level.

2. Method according to claim 1,
   characterized by the following additional process steps prior to process step a):
   a1) the oxygen content in the space being monitored is measured;
   a2) the reduction to the base inerting level takes place in accordance with the measured value of the oxygen.

3. Method according to claim 1 or 2,
   characterized by the following additional process step prior to process step b):
   b1) in the event of a fire, a detector for fire characteristics sends a complete inerting signal.

4. Method according to claim 1 or 2,
   characterized by the following additional process step prior to process step b):
   b1) representative samples are constantly extracted from the air in the space being monitored, which are fed to a detector for fire characteristics, which detector sends a complete inerting signal in the event of a fire.

5. Method according to one of claims 1 to 4, characterized in that reducing and maintaining the desired base inerting level is implemented by means of producing and/or introducing oxygen-expulsion gases.

6. Method according to one of claims 1 to 4, characterized in that reducing and maintaining the desired base inerting level is implemented by means of an oxygen extraction device.

7. Method according to one of claims 1 to 6, characterized in that the rapid further reduction of the oxygen content to the complete inerting level is implemented by introducing an oxygen-expulsion gas into the enclosed space.

8. Method according to claim 7, characterized in that the oxygen-expulsion gas is provided in gas cylinders.

9. Method according to one of claims 5 to 8, characterized in that the introduction of oxygen-expulsion gases is carried out in accordance with the measured oxygen content.

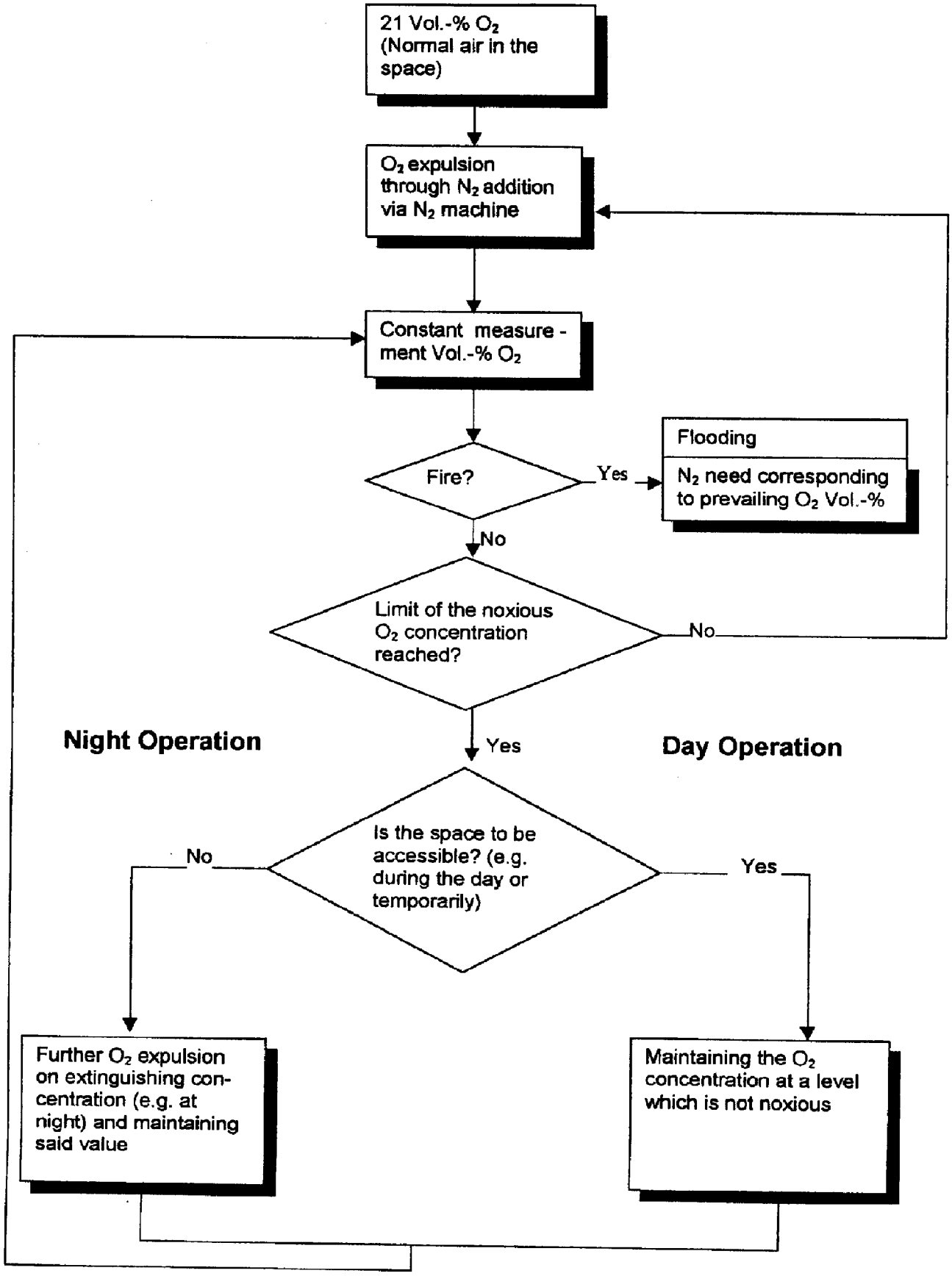
10. Device for carrying out the method according to one of claims 1 to 9, comprising
an oxygen measuring device in the space being monitored;
a first system for producing the oxygen-expulsion gas or for extracting oxygen from the space being monitored;
a second system for rapidly feeding an oxygen-expulsion gas into the space being monitored; and
a fire detection device for detecting a fire characteristic in the air in the space,
characterized by

a control unit sending a base inerting signal to the first system in accordance with the oxygen content of the air in space being monitored, and sending a complete inerting signal to the second system in accordance with a detection signal from the fire detection device.

11. Device according to claim 10,
characterized in that the fire detection device is an aspirative fire detection device.

12. Device according to claim 11,
characterized in that the oxygen measuring device is integrated in the detector housing of the fire detection device.

13. Device according to one of claims 10 to 12,
characterized in that the production of the oxygen-expulsion gases for obtaining the base inerting level takes place mechanically, for example, by means of a nitrogen machine.


21 Vol.-% O_2 (Normal air in the space)
O_2 expulsion through N_2 addition via N_2 machine
Constant measure - ment Vol.-% O_2
Fire?
Yes
Flooding
N_2 need corresponding to prevailing O_2 Vol.-%
No
Limit of the noxious O_2 concentration reached?
No
Night Operation
Yes
Day Operation
Is the space to be accessible? (e.g. during the day or temporarily)
No
Yes
Further O_2 expulsion on extinguishing con- centration (e.g. at night) and maintaining said value
Maintaining the O_2 concentration at a level which is not noxious